

NAME	INDEX NUMBER
SCHOOL	DATE _____

## THE MOLE

**1. 1989 Q 3**

- a). 0.318g of an oxide metal **M** was completely reduced by hydrogen gas to 0.254g of metal. Calculate the empirical formula of the metal oxide (**M** = 63.5, **O** = 16.0).

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- b). The mass of one litre of gas X is found to be 2.22 times greater than the mass of 1 litre of oxygen. Calculate the relative molecular mass of X. (Assume that all volumes are measured at room temperature; **O** = 16.0). (2 marks).

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**2. 1989 PIAQ 29**

- Calculate the concentration of Sulphuric acid in moles per litre if 15cm<sup>3</sup> of the acid is completely neutralized by 20cm<sup>3</sup> of one molar potassium hydroxide. (2 marks)

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**3. 1990 PIA Q5**

20.0cm<sup>3</sup> of a sodium hydroxide solution containing 8.0g dm<sup>-3</sup> were required for complete neutralization of 0.18g of a dibasic acid. Calculate the relative molecular mass of the acid (Na=23.0, H=1.0, O=16.0). (2 marks)

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4. **1990 PIA Q9**

A salt contains 59.0% sodium and 41.0% oxygen. Given that the formula mass of the salt is 78. determine its formula. (Na = 23, O=16.0). (3 marks)

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5. **1990 PIA Q12**

An element H consists of isotopes of masses 10 and 11 with a percentage composition of 18.7% and 81.3% respectively. Determine the relative atomic mass of H. (2 marks)

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6. **1990 P1A Q 20**

Determine the volume of hydrogen gas formed when excess Zinc metal is added to 100cm<sup>3</sup> of one molar hydrochloric acid. (1 mole of gas occupies 24.0 litres at room temperature and pressure). (2 marks)

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7. **1992 P1A Q7**

Calculate the number of chloride ions 250 cm<sup>3</sup> solution M1 calcium chloride.  
(Avagadros number is  $6.0 \times 10^{23}$ )

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8. 1992 P1A Q29

(a) An organic compound P contains 64.9% carbon, 13.5% hydrogen and 21.6% oxygen. The relative formula mass of P is 74.

Given that C=12.0, H=1.0, O=16.0

(i) Determine the empirical formula of P. (3 marks)

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(ii) Determine the molecular formula of P.

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(iii) When P was mixed ethanoic acid and a few drops of concentrated sulphuric acid added a pleasant smelling liquid R, was formed. P also reacted with sodium metal to produce a gas S.

I To what class of organic compounds do the following compounds belong.

P..... (1 mark)

R..... (1 mark)

II. Name gas S. .... (1 mark)

III. Write a possible structure of P. (1 mark)

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IV. Write the equation for the reaction which produces gas S. (1 mark)

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(iv) Compounds M and P belong to the same class of compounds. M has a relative

formula mass of 102. Which of the two compounds would be less soluble in water? Explain your answer

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9. 1993 P1A Q7

Determine the empirical formula of a compound made up of carbon and hydrogen only. Given that the percentage of carbon in the compound is 79.9% (C-12.0, H-1.0) (3 marks).

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10. 1993 P1A Q9

22.2cm<sup>3</sup> of sodium hydroxide solution, containing 4.0g per litre of sodium hydroxide were required for complete neutralisation 0.1g of a dibasic acid. Calculate the relative formula mass of the dibasic acid (Na-23, O-16.0, H-1.0) (3 marks).

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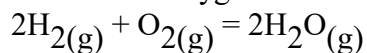
11. 1994 P1A Q3

When 34.8g of hydrated sodium carbonate (Na<sub>2</sub>CO<sub>3</sub>·xH<sub>2</sub>O) were heated to a constant mass. 15.9g of anhydrous sodium carbonate were obtained. Calculate the value of x in the hydrated carbonate. (Na=23.0, O=16.0, C=12.0, H=1.0) (3 marks)

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12. 1994 PPIA QUE 16

Hydrogen reacts with oxygen as shown in the equation:

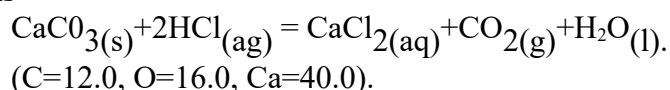


In an experiment, 100cm<sup>3</sup> of hydrogen gas was mixed with 100cm<sup>3</sup> of oxygen gas and the mixture heated to form H<sub>2</sub>O(g). Which of the gases was in excess and by how much? (2 marks)

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13. 1995 P1A Q3

Calculate the amount of calcium carbonate that would remain if 15.0g of calcium carbonate were reacted with 0.2 moles of hydrochloric acid. The equation for the reaction is



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14. 1995 PPIA Q14

A compound has an empirical formula. C<sub>3</sub>H<sub>6</sub>O and a relative formula mass of 116.

a) Determine its molecular formula. (H=1.0, C=12.0, O=16.0) (2 marks)

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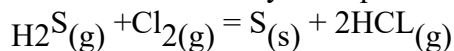
b). Calculate the percentage composition of carbon by mass in the compound. (1 mark)

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**15. 1996 PIA Q 24**

In an experiment, 2.4g of sulphur was obtained by reacting hydrogen sulphide and chlorine as shown by the equation below:



a). Which of the reactants acts as a reducing agent in the above reaction? Explain. (1 mark)

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b) Given that the yield of sulphur in the above reaction is 75%, calculate the number of moles of  $\text{H}_2\text{S}(\text{g})$  used in the reaction. (S=32.0). (2 marks)

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**16. 1997 P1A QUE 19**

(a) The empirical formula of a hydrocarbon is  $\text{C}_2\text{H}_3$ .  
The hydrocarbon has a relative molecular mass of 54. (H=1.0, C=12.0).  
(i) Determine the molecular formula of the hydrocarbon. (1 mark).

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(ii) Draw the structural formula of the hydrocarbon. (1 mark)

- (iii) To which homologous series does the hydrocarbon drawn in (b) above belong?

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(b) 90cm<sup>3</sup> of 0.01M calcium hydroxide were added to a sample of water containing 0.001 moles of calcium hydrogen carbonate.

- (i) Write an equation for the reaction which took place. (1 mark)

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- (ii) Calculate the number of moles of calcium ions in 90cm<sup>3</sup> of 0.01M calcium hydroxide. (1 mark).

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- c). What would be observed if soap solution was added dropwise to a sample of the water after the addition of calcium hydroxide? give a reason. (1 mark).

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17. 1997 P1A Q 28

Calculate the mass of nitrogen dioxide gas that would occupy the same volume as 10g of hydrogen gas at same temperature and pressure. (H=1.0, N=14.0, O=16.0) (2 marks)

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18. 1998 P1A Q6

On complete combustion of a sample of a hydrocarbon, 3.52g of carbon dioxide and 1.44g of water were formed. Determine the molecular formula of the hydrocarbon.

(Relative molecular masses of hydrocarbon = 56, carbon dioxide = 44, water = 18 and relative atomic masses H=1.0, and C=12.0). (4 marks).

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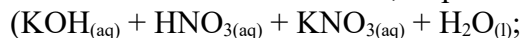
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**19. 1999 P1A Q7**

Write the formula of the sulphate of an element whose atomic number is 5.  
(C is not the actual symbol of the element) (1 mark).

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**20. 1999 P1A Q 10**

Dg of potassium hydroxide were dissolved in distilled water to make 100cm<sup>3</sup> of solution. 50cm<sup>3</sup> of the solution required 50cm<sup>3</sup> of 2M nitric acid for complete neutralization. Calculate the mass D, of potassium hydroxide.



Relative formula mass of KOH –56)

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**21. 1999 Q 4b P2**

b) In an experiment 3.36g of iron filings were added to excess aqueous copper(II) sulphate. Calculate the mass of copper that was deposited Cu = 63.5, Fe = 56.0



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21. 2000 Q 11

20.0cm<sup>3</sup> of a solution containing 4 gm per litre of sodium hydroxide was neutralized by 8.0cm<sup>3</sup> of dilute sulphuric acid. Calculate the concentration of sulphuric acid in moles per litre (Na = 23.0, O = 16.0, H = 1.0)

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22. 2001 Q 10

A weighed sample of crystalline sodium carbonate (Na<sub>2</sub>CO<sub>3</sub>. H<sub>2</sub>O) was heated in a crucible until there was no further change in mass. Calculate the number of moles (n) of the water of crystallization

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23. 2003 Q6

When excess dilute hydrochloric acid was added to sodium, 960cm<sup>3</sup> of sulphur (IV) oxide gas was produced. Calculate the mass of sodium sulphite that was used. (molar mass of sodium = 126 g and molar gas volume= 24000cm<sup>3</sup>) (3marks)

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24. 2004 Q 14

When X cm<sup>3</sup> of a solution of 0.5m magnesium carbonate was 8.4g.

a) Write the ionic equation for the reaction that took place  
(1mark)

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b) Calculate the value of X. (C = 12.0, Mg 24.0; O=16.0)  
(2marks)

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25. 2005 Q 9

A certain carbonate,  $GCO_3$ , reacts with dilute hydrochloric acid according to the equation given below:



If 1 g of the carbonate reacts completely with 20 cm<sup>3</sup> of 1 M hydrochloric acid, Calculate the relative atomic mass of G (C = 12.0 = 16.0)

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26. 2005 Q 2b P2

(b) Sodium hydroxide pellets were accidentally mixed with sodium chloride 17.6 g of the mixture were dissolved in water to make one litre of solution. 100 cm<sup>3</sup> of

the mixture were dissolved in water to make one litre solution.

100cm<sup>3</sup> of the solution was neutralized by 40cm<sup>3</sup> of 0.1M sulphuric acid

(i) Write an equation for the reaction that took place

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(ii) Calculate the:

(i) Number of moles of the substance that reacted with sulphuric acid  
(2marks)

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(ii) Number of moles of the substances that would react with sulphuric acid in the one litre of solution

(1 mark)

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(iii) Mass of the unreacted substances in one litre of solution (2 marks)

(H = 1,0 ; Na = 23.0 ; Cl= 35.5 ; O= 16.0)

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26. 2006 Q 8 (P1),7c-g P2

8. When 94.5g of hydrated barium hydroxide,  $ba(OH)_2 \cdot nH_2O$  were heated to constant mass, 51.3g of anhydrous barium hydroxide were obtained.

Determine the empirical formula of the hydrated barium hydroxide. (3 marks)

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7c The table below shows the volumes of nitrogen dioxide gas produced when different volume of 1M nitric acid were each reacted with 2.07 g of lead at room temperature.

Volume of 1 M nitric acid (cm <sup>3</sup> )	Volume of nitrogen dioxide gas (cm <sup>3</sup> )
5	60
15	180
25	300

35	420
45	480
55	480

c) On the grid provided below, plot a graph of the volume of the gas produced (Vertical axis) against volume of acid. (3 marks)

d) Using the graph, determine the volume of:  
 i) Nitrogen dioxide produced when 30cm<sup>3</sup> of 1 M nitric acid were reacted with 2.07 g of lead (1mark)

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ii) 1M nitric acid which would react completely with 2.07g of lead. (1mark)

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e) Using the answer in d(i) above, determine:  
 i) The volume of 1M nitric acid that would react completely with

one mole of lead (Pb=207)  
(2marks)

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ii) The volume of nitrogen dioxide gas produced when one mole of lead reacts with excess 1 M nitric room temperature.  
(1mark)

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f) Calculate the number of moles of:  
i) 1M nitric acid that reacted with one mole of lead  
(1mark)

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ii) Nitrogen dioxide produced when one mole of lead were reacted with excess nitric acid. (Molar gas volume of 2400cm<sup>3</sup>)  
(1mark)

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g) Using the answers obtained in f (i) and (ii) above, write the equation for the reaction between lead and nitric acid given that one mole of lead nitrate and two moles of water were also produced.  
(1mark)

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**28. 2007 Q 20**

An alcohol has the following composition by mass: hydrogen 13.5%, oxygen 21.6% and carbon 64.9%

a) Determine the empirical formula of the alcohol( $C=12.0$ ;  $H=1.0$ )= $16.0$ ).

(2marks)

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**29. 2007 Q 22**

6.84g of aluminium sulphate were dissolve in 150cm<sup>3</sup> of water. Calculate the molar concentration of the sulphate ions in the solution.(Relative formula mass of aluminium sulphate is 342)

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**30. 2008 Q 2**

When a hydrated sample of calcium sulphate  $CaSO_4 \cdot XH_2O$  was heated until all the water was lost, the following data recorded;

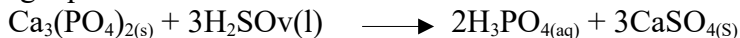
Mass of crucible	=	30.296 g
Mass of crucible +hydrated salt	=	33.111 g
Mass of crucible + anhydrous salt	=	32.781 g

Determine the empirical formula of the hydrated salt (Relative formula mass of  $\text{CaSO}_4 = 136$ ,  $\text{H}_2\text{O} = 18$ ).  
(3marks)

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31. 2008 Q 5

Phosphoric acid is manufactured from calcium phosphate according to the following equation.



Calculate the mass in (Kg) of phosphoric acid that would be obtained if 155 Kg of calcium phosphate reacted completely with the acid

(Ca=40, P=31, S=32, O=16, H=1)

(2marks)

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32. 2008 Q 27

In an experiment to determine the percentage of magnesium hydroxide in an anti-acid, a solution containing 0.50 g of the anti-acid was neutralized by  $23.0 \text{ cm}^3$  of 0.010m hydrochloric acid (Relative formula mass of magnesium hydroxide =58)

a) Mass of magnesium hydroxide in the anti-acid;

(2marks)

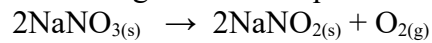
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b) Percentage of magnesium hydroxide in the anti-acid  
(1mark)

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33. 2009 Q 13

When 8.53g of sodium nitrate were heated in an open tube the mass of oxygen gas produced was 0.83g. Given the equation of the reaction as



Calculate the percentage of sodium nitrate that was converted to sodium nitrite (Na= 23.0, N = 14.0 ,O = 16.0)

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34. 2011 Q 26

The data given below was recorded when metal M was completely burnt in air. M is not the actual symbol of the metal.

(R.A.M; M=56,0=16)

Mass of empty crucible and lid=10.240g  
Mass of crucible, lid and metal M=10.352g



Mass of crucible, lid and metal oxide = 10.400g

a) Determine the mass of:

i) Metal M (½ mark)

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ii) Oxygen (½ mark)

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b) Determine the empirical formula of the metal oxide. (2 marks)

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**35. 2012 Q8 P1**

10cm<sup>3</sup> of concentrated sulphuric (VI) acid was diluted to 100cm<sup>3</sup>. 10cm<sup>3</sup> of the resulting solution was neutralised by 36cm<sup>3</sup> of 0.1M sodium hydroxide solution. Determine the mass of sulphuric (VI) acid that was in the concentrated acid (s = 32.0; H = 1.0; O = 16.0).

(3marks)

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